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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 190.

Experiment Station Work,

XXIV.

Compiled from the Publications of the Agricultural Experiment Stations.

COST OF EGGS IN WINTER.
THE CHICKEN MITE.
SOILING CROPS.
PROFITABLE AND UNPROFITABLE COWS.
METHODS OF MILKING.
COATING CHEESE WITH PARAFFIN.
THE OCTAGONAL SILO.
VENTILATION OF STABLES.
DISPOSAL OF DISEASED CARCASSES.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.

A. C. TRUE, Director.

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EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

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EXPERIMENT STATION WORK.[a]

COST OF PRODUCING EGGS IN WINTER.[b]

The New York Cornell Experiment Station has recently reported a series of observations made by Prof. H. H. Wing on the amount and cost of food consumed and number of eggs produced during the four winter months by a number of flocks of hens in different parts of the State. These observations were made during the winters of 1901–2 and 1902–3 in cooperation with practical poultry raisers, the purpose being "to get at the average cost of eggs under ordinary commercial conditions."

The results, briefly summarized, were as follows:

In the seventeen weeks from December 1, 1901, to March 29, 1902, and in the similar period of 1902–3, in 29 flocks, representing 10 owners and 5,200 fowls, the average daily production of eggs was 22.8 per 100 fowls.

During the same period the average food cost of 1 dozen eggs was nearly 18 (17.7) cents. The flocks that laid most eggs during December and January laid most eggs also in March.

The egg production of pullets was notably in excess of that of hens, particularly in the earlier periods when the price of eggs was highest.

The average cost of feeding 100 hens for 17 weeks was $35.33.

The average value of product exceeded the cost of food by $16.13 per 100 fowls.

Commenting on the results, Professor Bailey says:

A most instructive feature of these records is the immense range in the cost of producing eggs, a range that runs practically from 6 cents to $6 the dozen. On examination it is found that this remarkable range is not correlated closely with breed, character of building, or kind and quantity of food, although all these factors have an influence. One cause of this difference seems to be a difference in the hens themselves—some hens are good layers and some poor layers, as some apple trees are good bearers and some poor bearers. What the reason is of this difference in what we call individuality we do not know, but it is probable that individual fowls may stamp their capabilities on their progeny as markedly as individual cows may transmit good or bad milking qualities. At all events, it is not sufficient that the poultryman pay attention to housing and feeding alone. He must also give attention to breeding, choosing hatching eggs from parents of known performance.

It is just such questions as the latter that are being studied in experiments begun at the Maine Station in 1898. In these experiments

[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from Maine Sta. Bul. 93; New York Cornell Sta. Bul. 212.

birds which had been shown by careful trap-nest records[a] to have yielded "200 or more eggs [per year] of good shape, size, and color were selected for 'foundation stock,' upon which, with the additions made to them in succeeding years of birds of similar quality, the breeding operations were to be based." Of these experiments Professor Gowell says:

It is yet too early to report what the results of this work are to be. Sufficient time has not elapsed since beginning the tests to increase egg production or establish claims of increased productiveness.

During the four years in which we have been selecting breeding stock by use of the trap nests, we have given full year tests to over a thousand hens and have found among them 35 that have yielded from 200 to 251 eggs each in a year. Several have each yielded only from 36 to 60 eggs, and three have never laid at all, to the best of our knowledge.

A study of the monthly record sheets shows not only great differences in the capacities of hens, but marked variations in the regularity of their work, some commencing early in November and continuing to lay heavily and regularly month after month, while others varied much, laying well one month and poorly or not at all the next. We are not able to account for these vagaries, as the birds in each breed were bred alike and selected for their uniformity. All pens were of the same size and shape and contained the same number of birds. Their feeding and treatment were alike throughout.

These investigations teach the importance of watching closely the egg production of the individual hens of the flock and gradually eliminating those which do not make a profitable return in eggs for the care and feed given them. By this selective process it would be possible to build up flocks of hens of high laying capacity, just as dairy herds are improved by similar means (see p. 14). It is well known, however, that the character of the feed and the method of feeding, as well as housing, etc., have much to do with the laying capacity of hens, especially in winter.[b]

COMBATING THE CHICKEN MITE.[c]

The chicken mite (*Dermanyssus gallinæ*) is generally distributed throughout the world wherever chickens are raised. The adult mite is of a light-gray color with dark spots showing through the integument and is about 1 millimeter (less than 0.04 inch) long. When filled with blood the color of the mite is decidedly red.

The usual habit of the mite is to attack fowls at night and to hide in cracks and corners or under rubbish by day. In exceptionally bad cases of infestation mites remain on the fowls during the daytime.

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[a] For description of the trap nest used see U. S. Dept. Agr., Farmers' Bul. 114, p. 19.

[b] U. S. Dept. Agr., Farmers' Bul. 186, p. 23.

[c] Compiled from Iowa Sta. Buls. 33, 69; Mississippi Sta. Bul. 78; Virginia Sta. Bul. 114; Insect Life, Vol. VI, p. 342; U. S. Dept. Agr., Division of Entomology Bul. 5; Diseases of Poultry, by D. E. Salmon, pp. 169, 179.

Often, however, an examination of fowls during the day will fail to reveal the presence of any mites, although the same fowls are badly infested at night. The presence of filth, such as droppings, rotten eggs, or other rubbish, is favorable to their multiplication, as is also a careless construction of buildings, which furnish hiding places for the mites. This mite attacks all kinds of farm poultry, including pigeons, and also wild birds which nest about barns, especially swallows. Occasionally it infests man, horses, and other mammals, producing symptoms of scabies by its bites. Young chickens and sitting hens are most seriously infested by this pest. At the Mississippi Experiment Station the mites were observed "so numerous that they actually hung in festoons to the sides of the nest boxes." At this station and also in Iowa the chicken mite is considered one of the most formidable difficulties in chicken raising. At the Iowa Station sitting hens were occasionally killed outright by the mites.

Several remedies have been suggested for the control of the pest. The Division of Entomology of this Department recommends the destruction of the nests of swallows and pigeons about poultry houses, the removal of rubbish, provision of a dust bath for the fowls, and spraying the houses and roosts with kerosene, kerosene emulsion, benzine, gasoline, or whitewash, or dusting with carbolated lime. Dr. D. E. Salmon recommends dipping infested fowls in a 1 per cent solution of carbolic acid for 1 minute, or in a solution of creolin, using this substance at the rate of 2½ ounces per gallon of water. The same author suggests the addition of pyrethrum or sulphur to the dust bath, application of carbolated lime as a wash, fumigation of the henhouses with sulphur, and the direct application of pyrethrum to infested fowls. The Virginia Station recommends spraying the walls, floors, and roosts of badly infested houses with a 2 per cent solution of crude carbolic acid at intervals of two weeks.

Recent experiments at the Iowa and Mississippi stations in combating the chicken mite have shown that cleanliness is of prime importance, that all filth must be removed and all cracks exposed if any treatment is to be effective. Nests and roosts should be of simple construction and removable in order to facilitate thorough disinfection. Poultry houses should be constructed so as to furnish no hiding places for the mites. At the Mississippi Station henhouses were kept free from mites by thorough dusting with lime and sulphur at intervals of two weeks, treating the nests with crude petroleum, and placing moth balls in the nests, but not in contact with the eggs. At the Iowa Station Dr. Repp had the best results from the use of kerosene emulsion made of ½ pound hard soap, 2 gallons kerosene, and 1 gallon water, the mixture being diluted with 10 volumes of soft water before using. All parts of poultry houses must be thoroughly moistened, particular

attention being given to cracks, holes, joints, and other hiding places. This application should be made three times in rapid succession on the same day. Some of the eggs of the mites escape this treatment and the application should therefore be repeated at intervals of about three days for a period of two weeks.

With this system of disinfection it is usually unnecessary to treat the hens directly, since the mites leave them during the day and are killed by the application of kerosene emulsion. The extermination of the mites may be hastened, however, by dusting the hens with pyrethrum powder after they have gone to roost on the evening before the insecticide treatment is applied. A good spray pump should be used in applying the kerosene emulsion, so that the material may be thrown into all cracks and corners. According to the experience of the Iowa Station the method is an inexpensive one. The material necessary for spraying ordinary farm henhouses costs about 45 cents.

A SUCCESSION OF SOILING CROPS FOR DAIRY COWS.[a]

The experience of many farmers who rely solely upon pasture as a means of subsistence for their dairy herds has been that very frequently, if not generally, during the months of July, August, and September the grass becomes dry and hard and is not relished by the animals. Without other source of nourishment at this time, the stock usually declines in condition, actually losing flesh, and in the case of the dairy cow a marked reduction in the production of milk occurs. There is hardly a section of the country in which pasturage at one time or another during the growing season is not inadequate. It is our purpose to call attention here to results obtained at several experiment stations in the study of how soiling crops may be provided for the entire season, or that portion of it in which a shortage of grass is most likely to occur.

Two systems of soiling are in vogue, the complete and the partial. When complete soiling is practiced the cows are not allowed to graze, but are fed in barns or feed yards, the green feed being brought to them several times during the day. This system has a limited application and is essentially a feature of intensive farming. It requires more labor than other methods of feeding, but the same area of land will feed a larger number of cows. Among other advantages of the system the increase in the quantity and the improvement in the quality of the manure, the protection afforded the animals against the heat of the sun and the worry of the flies, which is of especial benefit to dairy cows, may be mentioned. Partial soiling consists in the practice of feeding green forage in addition to pasturage. This system may be

[a] Compiled from New Jersey Stas. Bul. 158; Rpt. 1902, p. 296; South Dakota Sta. Bul. 81; Wisconsin Sta. Bul. 103.

profitably and advantageously applied in many localities where farming is carried on more or less extensively. Partial soiling may be practiced in two different ways, one by feeding green forage to the animals while kept in pastures or paddocks, the other by keeping the cows in a barn where they are fed with newly mown forage during the day and then turned out to pasture during the night.

In addition to results in growing various crops for green forage the Wisconsin Station reports a comparison of the average monthly yield of milk for four years of 15 farmers' herds, and the average monthly yield for the past two years of the university herd, which was partially fed on soiling crops. In the case of the farmers' herds a rapid falling off from the highest yield in June to almost the lowest yield for the year in August is shown, after which it remains practically constant, being slightly lower in November than in August. The milk production of the university herd reached the maximum in April, remained almost constant until June, after which it declined gradually and reached its lowest point in October, when the soiling crops had all matured and the silos had not yet been opened. One of the most serious obstacles in the way of the more general adoption of a system of soiling is the difficulty of establishing a suitable rotation of crops and determining the best methods of feeding them. This very practical phase of the subject is being carefully studied by several of the experiment stations.

Based on the data obtained at the Wisconsin Station during several years of growing and feeding soiling crops, the succession proposed in the following table is regarded as capable of supplying satisfactory soiling for dairy cows from May until October, under approximately normal conditions in Wisconsin:

Succession of soiling crops for dairy cows in Wisconsin.

Crop.	Seed per acre.	Time of sowing.	Approximate period of cutting.	Average yield per acre.		Daily feed per cow.	Area required for 10 cows.
				Green forage.	Dry matter.		
	Pounds.			*Tons.*	*Tons.*	*Pounds.*	*Acres.*
Fall rye	168.0	Sept. 10	May 15 to June 1	8.41	2.0	38	1/3
Alfalfa	20.0		June 1 to 15	16.50	4.7	36	1/3
Red clover	15.0		June 15 to 25	10.00	2.9	36	1/5
Peas and oats	[a]108.0	Apr. 16	June 25 to July 5	9.68	3.4	32	1/6
Do	108.0	Apr. 26	July 5 to 15	9.68	3.4	32	1/6
Oats	80.0	May 5	July 15 to 25	9.38	3.6	32	1/6
Second-crop alfalfa			July 15 to 30	16.50	4.7	36	
Rape	2.5	May 26	Aug. 1 to 15	26.83	4.2	42	1/8
Flint corn		May 20	Aug. 1 to 25	15.52	3.1	40	1/8
Sorghum	50.0	June 1	Aug. 25 to Sept. 10	29.83	6.1	39	1/10
Evergreen sweet corn		May 31	Sept. 10 to 25	24.39	5.1	39	1/8
Rape	2.5	July 20	Sept. 25 to Oct. 10	26.83	4.2	42	1/8
Total				203.55	47.4		

[a] Oats, 48 pounds; peas, 60 pounds.

Nearly all of the crops grown were most palatable and satisfactory when fed at or a little before full bloom. When harvested either too green or too ripe the forage lost much of its palatability, and consequently was not readily consumed. Thick seeding in general gave a much greater yield and a better quality of forage than thin seeding. This was especially the case with the different kinds of corn and with sorghum, but was also noticeable with oats and peas as well as with barley and rye. Early Amber sorghum from northern-grown seed is considered the most valuable soiling crop for Wisconsin, although Evergreen sweet corn gave almost as good results as sorghum.

Owing to the fact that the highest degree of palatability of any one crop extends over only a comparatively short time, provision should be made for a close succession of the crops intended for soiling.

In estimating the quantity of daily feed per cow and the acreage to furnish feed for 10 animals, it is presupposed that a good pasture is provided for grazing during the night in addition to the soiling crops fed. The land area required to produce enough of this succession of crops to supply 10 cows as given in the last column of the table amounts in the aggregate to about 1.9 acres.

The New Jersey Station has reported the results of seven years' experiments with soiling crops. The different crops experimented with are here noted in the order they were used at the station throughout the season.

The first crop harvested in the spring was rye, which was usually ready for feeding by May 1 and lasted for twelve or fifteen days. The seedings had been made at different times in the fall. When soiling is not expedient the crop may be pastured. It is, however, more wasteful than soiling. A top-dressing of 150 pounds nitrate of soda per acre in the spring is recommended.

Wheat immediately following rye did not yield as heavily, but remained succulent for a longer time and could be fed about May 15.

Alfalfa the third season after seeding gave a total yield of 26.6 tons per acre from five cuttings. This crop is ready for use in New Jersey from about May 15 to 25. It is cut just before blooming. Broadcasting from 30 to 35 pounds of seed per acre the last of April or first of May on well-prepared soil without a nurse crop gave the most generally successful results. In 1902 an acre plat of alfalfa was cut five times during the season and gave a total yield of 20.11 tons of green forage. The average yield for five years on this plat, 19.32 tons of green forage, equivalent to 4.83 tons of hay, was produced at a total cost of $26.57. Disking alfalfa fields this season in August immediately after cutting the crop induced a vigorous growth and a general branching of the crown roots.

Crimson clover is regarded as one of the most valuable forage crops of the State. It has been grown at the station as a catch crop by sowing 12 pounds of seed per acre in corn at the last cultivation. In this way these two crops were obtained the same season from the same land for a number of years in succession with noticeable benefit to the soil. A stand was secured without difficulty and, with a few exceptions, the crops stood the winters well.

After crimson clover a mixture of red clover, alsike clover, and timothy has given good results. Very palatable forage was furnished by this mixture for ten to thirty days, the length of the period depending upon the proportion of timothy. A mixture of only red clover and alsike clover may also be used in the place of the rotation.

A crop of oats and Canada field peas is considered one of the most serviceable in the succession of forage crops. In the experience of the station good results were obtained by mixing the oats and peas and sowing them together, with the drill running to a medium depth. Sowing 2 bushels of oats and 1½ bushels of peas per acre not later than May 1 has given the best returns. The variety of pea generally used is the Golden Vine.

For general forage purposes corn proved superior to any and all crops grown. White Flint, a succulent variety with a vigorous leaf growth and a tendency to sucker abundantly, was found one of the best for the purpose. Sweet corn was eaten more completely than the larger varieties of corn, but it showed no advantages in this respect over White Flint. Among several varieties of corn tested in this connection in 1902 Monmouth White and White Flint were the most productive, yielding 16.28 and 14.85 tons of forage per acre, respectively.

Japanese barnyard millet proved the most profitable of several varieties of millet grown. Pearl millet gave large yields of succulent and palatable forage, but owing to its watery character is not considered equal to the Japanese barnyard variety.

The best yields of forage from cowpeas were obtained from sowing 1½ bushels of peas per acre with a grain drill about June 1. The varieties recommended for soiling are Clay, Whip-poor-will, Black, and Wonderful. The experiments indicate that where cowpeas can be successfully grown they possess all the advantages of soy beans.

For late soiling barley or barley and peas are recommended. At the station barley is sown the first week of August at the rate of 2 bushels per acre. If the weather is cool and moist, from 6 to 8 tons per acre of crop are obtained, and this can be fed in October or November. Seeding rye with barley in August or September has given excellent results. The barley is cut the last of October and the rye holds over winter and makes an early start in the spring.

The station dairy herd has been successfully fed on soiling crops during the growing season for seven years. In 1902 a herd equivalent to 50 full-grown animals was fed on green forage from May 1 to October 16. In addition to an average of 61 pounds of roughage daily each animal was fed 7.2 pounds of a ration of wheat bran, dried brewers' grains, malt sprouts, and corn meal or rice meal. The record of the cost of producing the forage, the time of cutting and seeding, and the yield per acre in connection with this work is given in the table below:

Cost and yield of soiling crops at the New Jersey stations in 1902.

Crop.	Area.	Date of seeding.	Seed used.	Period of cutting and feeding.	Yield.	Total cost.
	Acres.		*Bush.*		*Tons.*	
Rye	2	Oct. 10, 1901	4	May 1–4	4.20	$5.50
Do	2	Oct. 2, 1901	4	May 4–16	11.31	8.60
Wheat	2	Oct. 9, 1901	4	May 16–26	10.60	8.60
Alfalfa (first cutting)	1.87	May 23, 1901	1	May 26–31	6.01	5.13
Do	1	May 14, 1898	7/12	May 31–June 6	7.36	2.48
Peas and oats	2	Mar. 26, 1902	a 6½	June 6–14	12.04	17.54
Do	2	Apr. 14, 1902	b 7	June 14–21	10.44	20.08
Do	2	Apr. 17, 1902	b 7	June 21–July 1	17.08	16.78
Alfalfa (second cutting)	1.87			July 1–5	5.85	
Do	1			July 5–9	6.19	
Mixed grasses	1			July 9–14	6.70	
Cowpeas	5	May 22, 1902	7½	July 14–Aug. 6	42.80	43.78
Soy beans and sorghum (second crop).	1	June 4, 1902	c 1½	Aug. 6–10	7.25	8.57
Cowpeas and sorghum (second crop).	1	.....do	c 1½	Aug. 10–13	6.70	9.32
Barnyard millet (second crop)	2	June 16, 1902	1⅛	Aug. 13–22	20.01	14.32
Cowpeas (second crop)	1	June 9, 1902	2	Aug. 22–28	12.00	11.41
White flint corn	1	May 9, 1902	¼	Aug. 28–Sept. 3	10.50	7.22
Do	1	June 18, 1902	⅓	Sept. 3–9	10.00	7.88
Corn (variety test, second crop)	1	.....do	⅓	Sept. 9–20	14.14	9.38
White flint corn (second crop)	2	July 2, 1902	⅔	Sept. 20–Oct. 2	14.95	17.64
Southern white corn	1	May 1, 1902	½	Oct. 2–9	11.00	7.92
Cowpeas	1	July 8, 1902	2	Oct. 9–13	6.41	10.45
Barley (third crop)	2	Aug. 19, 1902	3	Oct. 13–16	3.56	11.19
Total	37.74				257.00	242.49

a Oats, 2½ bushels; peas, 4. b Oats, 3 bushels; peas, 4. c Sorghum, ½ bushel; soy beans and cowpeas, 1.

The results of the season with the soiling crops grown at the station show that the average yield per acre was 13.9 tons. According to records kept for several years an acre of land furnished green forage for 3¼ cows for six months. Records for six years show that during the six months when forage crops were fed each cow produced on an average 3,457 pounds of milk with 4.31 per cent of fat and 173.8 pounds of butter, as compared with 3,050 pounds of milk with 4.38 per cent of fat and 156 pounds of butter during the six months when the same cows were fed silage.

As a result of their experiments the New Jersey stations recommend the following practical rotations:

Some practical rotations of soiling crops recommended by the New Jersey stations.

Crops in one-year rotation.	Time of seeding.	Time of cutting.	Yield per acre
			Tons.
1 Rye and crimson clover	September	May 1–10	8.05
Oats and peas	May 10	July 1–10	7.60
Soy beans	July 10	Sept. 1–10	9.00
Total			24.65
2 Wheat fodder	September	May 10–20	7.00
Cowpeas	May 20	July 10–20	8.20
Japanese millet	July 20	Sept. 10–20	7.00
Total			22.20
3 Oats and peas	Apr. 1	June 10–20	7.34
Japanese millet	June 20	Aug. 1–10	8.73
Barley and peas	Aug 10	Oct. 10-20	6.03
Total			22.10
4 Oats and peas	Apr. 10	June 1–10	6.80
Cowpeas	June 10	Aug. 10–20	8.20
Barley and peas	Aug. 20	Oct. 20-30	6.30
Total			21.30
5 Rye	September	May 1–7	9.60
Cowpeas	June 10	Aug. 25–Sept. 1	10.50
Barley	Sept. 2	Oct. 27 Nov. 1	2.60
Total			22.70
6 Rye	October	May 7–19	9.60
Soy beans	June 10	Aug. 19–25	8.80
Barley	Sept. 2	Oct. 27–Nov. 1	2.60
Total			21.00
7 Crimson clover	July	May 20–June 1	8.00
Corn	June 1	July 20-Aug. 1	9.56
Total			17.56
8 Mixed grasses	September	June 20–30	7.00
Corn	June 20	Aug. 20–Sept. 1	12.24
Total			19.24
9 Rye and vetch	Sept. 10	May 10–19	8.60
Corn	May 27	July 20–29	11.80
Total			20.40
10 Rye	August	May 1–10	8.50
Pearl millet	May 18	Aug. 8 15	15.10
Total			23.60
11 Oats and peas	Aug. 10	June 16–23	10.20
Cowpeas	Aug. 1	Sept. 16–22	8.00
Total			18.20
12 Oats and peas	Aug. 21	June 29–July 6	10.20
Flint corn	July 10	Sept. 22–30	11.00
Total			21.20
13 Oats and peas	Apr. 2	June 26–July 4	6.20
Cowpeas and Kafir corn	July 10	Sept. 1–16	12.20
Total			18.40
14 Alfalfa, first year, two cuttings			8.00
Alfalfa, second year, four cuttings			20.21
Alfalfa, third year, five cuttings			26.60
Alfalfa, fourth year, four cuttings			21.70
Alfalfa, fifth year, five cuttings			20.11

In a recent bulletin from the South Dakota Station the following succession of crops is suggested as the one most likely to be successful in that State: Winter rye, sown August 20, for feeding in May and June; oats and peas, sown April 10, 20, and 30; corn, May 12, and rape, May 15, for supplying forage in July; corn, sown May 12; millet, oats and peas, and sorghum, sown June 1, and rape, sown from June 1 to June 20, for August forage; corn, sown May 20, sorghum, June 1, and rape, July 1, for September; and rape sown with corn or grain and winter rye, sown July 1, for feeding in October. These crops are to be supplemented by brome grass and alfalfa obtained from permanent fields and meadows.

PROFITABLE AND UNPROFITABLE COWS.[a]

The fact that individual cows differ widely in productive capacity and profitableness has been pointed out in previous numbers of this series of bulletins.[b] It was stated that a surprisingly large proportion of the dairy cows of the country not only yielded no profit, but were kept at an actual loss to their owners. The grade of our milch cows is undoubtedly being steadily improved, but that there is still abundant room for improvement is very clearly shown by the results of observations made by the Illinois Station among dairymen of that State, a number of whom "were persuaded to weigh and sample each mess of milk a sufficient number of times during the year so that the performance of each cow could be estimated with a considerable degree of accuracy." Observations on 8 herds containing 144 cows are reported.

Some of the herds returned their owners a good profit, others a small profit, and one herd was kept at a loss. Six herds out of the 8 contained cows that did not pay for the feed they consumed.

In estimating the profit or loss on a cow it was counted that the calf paid for her keep while dry and the skim milk paid for labor.

The cow that yielded the most product gave 8,949 pounds of milk, and made 472 pounds of butter. The poorest cow produced 1,482 pounds of milk, 68 pounds of butter, and the average production for all the herds, except [one], was 4,721 pounds of milk, 3.67 per cent fat, 173 pounds of butter fat, and 202 pounds of butter. * * *

The most profitable cow gave a net profit of $57.22 and the poorest cow was kept at an actual loss of $17.83. The average net profit was $9.96 per cow.

The above facts show clearly that the average production of the Illinois dairy cow can be doubled and the profit increased fourfold.

This can be done with little expense to the farmer. It will require better care and better feed for his stock, and the application of the scales and the Babcock test so that he can select and breed his animals more intelligently.

It is obvious that when these tests show the presence in a herd of a cow which is being kept at a loss or at a very small profit as compared with the other cows, the first step is to eliminate her from the herd and replace her by one of greater productive capacity. It is not likely

[a] Compiled from Illinois Sta. Bul. 85.

[b] U. S. Dept. Agr., Farmers' Buls. 65, p. 3; 114, p. 21; 162, p. 24.

that any amount of feed and good care will convert a cow like the one referred to above as being kept at a loss of over $17 into a profitable producer.[a]

METHODS OF MILKING.[b]

In a recent bulletin of the New York Cornell Station, dealing with this subject, Professors Wing and Foord say:

Milking the dairy cow is such a simple operation and one that occupies in the aggregate so much of the dairyman's time, that it is easy to become careless about it and to look upon the operation as one not requiring skill nor demanding scientific investigation. The feeding of the herd has received careful attention, both by investigators and farmers, until it is now probably correct to say that the dairy cow in the hands of the progressive dairyman is more scientifically fed and nourished than most children. The ventilation and sanitation of stables has also been the subject of much discussion, but it is certainly a fact that the art of milking has not received the attention it deserves, at least not until very recently.

The bulletin records experiments made to determine the loss due to failure to secure in the process of milking all of the milk secreted by the cow, being primarily a trial on the university herd of 12 cows and on two private herds of the Hegelund method of milking, recently tested and described by the Wisconsin Station. A comparison was also made of this method and of careful stripping as ordinarily practiced.

The Hegelund method of milking, which is really a series of manipulations of the udder, is described by Professor Woll, of the Wisconsin Station, as follows:

First manipulation.—The right quarters of the udder are pressed against each other (if the udder is very large, only one quarter at a time is taken) with the left hand

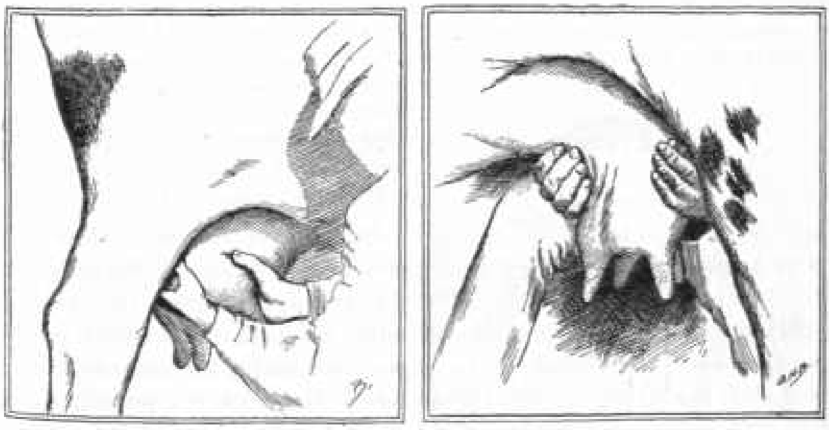

FIG. 1.—First manipulation in the Hegelund method of milking.

on the hind quarter and the right hand in front on the fore quarter, the thumbs being placed on the outside of the udder and the four fingers in the division between the two halves of the udder. The hands are now pressed toward each other and

[a] For fuller discussion of this subject see U. S. Dept. Agr., Farmers' Bul. 55.

[b] Compiled from New York Cornell Sta. Bul. 213, and Wisconsin Sta. Bul. 96.

at the same time lifted toward the body of the cow. This pressing and lifting is repeated three times, the milk collected in the milk cistern is then milked out, and the manipulation repeated until no more milk is obtained in this way, when the left quarters are treated in the same manner. (Fig. 1.)

Second manipulation.—The glands are pressed together from the side. The fore quarters are milked each by itself by placing one hand, with fingers spread, on the outside of the quarter and the other hand in the division between the right and left fore quarters; the hands are pressed against each other and the teat then milked. When no more milk is obtained by this manipulation, the hind quarters are milked by placing a hand on the outside of each quarter, likewise with fingers spread and turned upward, but with the thumb just in front of the hind quarter. The hands are lifted and grasp into the gland from behind and from the side, after which they are lowered to draw the milk. The manipulation is repeated until no more milk is obtained. (Fig. 2.)

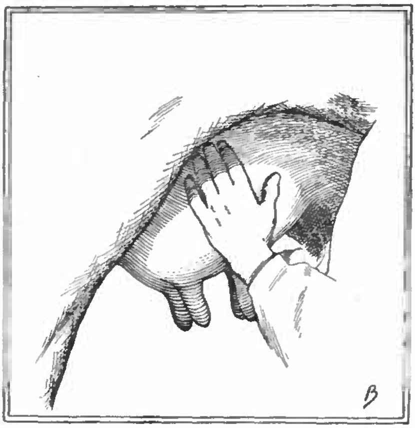

FIG. 2.—Second manipulation in the Hegelund method of milking.

Third manipulation.—The fore teats are grasped with partly closed hands and lifted with a push toward the body of the cow, both at the same time, by which method the glands are pressed between the hands and the body; the milk is drawn after each three pushes. When the fore teats are emptied the hind teats are milked in the same manner. (Fig. 3.)

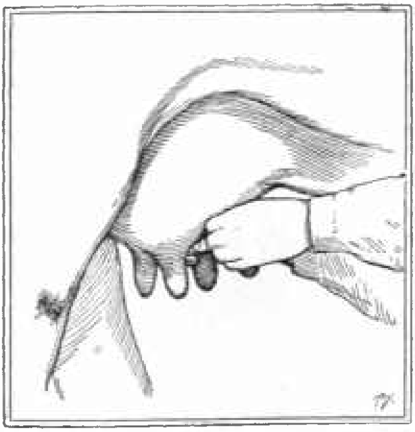

FIG. 3.—Third manipulation in the Hegelund method of milking.

In trials of this method on 142 cows of the Wisconsin Station herd the average amount of residual milk obtained was about 1 pound per head daily, the average butter fat in the milk 0.1 pound. The average fat content of the herd milk obtained in the regular milking was 4.29 per cent, of the residual milk 10.32 per cent, or 2.4 times as large as the former. The time required for after-milking by the method was from two to three minutes.

One man can readily after-milk 20 cows an hour if there are no extra weighings, sampling, and recording of weights to be done. We pay at this station 15 cents an hour for milking. This may be considered a rather high price under present conditions in the northwestern States. The after-milking of 20 cows would take a man about two hours a day and would therefore cost 30 cents. We have seen that we obtain on the average an immediate increase of about 1 pound of milk and one-tenth of a pound of butter fat per cow by the process of after-milking, or from 20 cows, 2 pounds of butter fat. If butter fat is worth 25 cents a pound (an average figure), the value of the increased yield would be 50 cents—that is, there would be a gain of 20 cents a day per 20 cows, or about $60 a year, as the direct and immediate gain from practicing the manipulation method.

It is pointed out by Professor Woll that, besides the immediate gain in milk and butter fat secured, the method has the decided advantage of stimulating milk secretion and thus prolonging the lactation period.

The results obtained by the New York Cornell Station bear out in general those of the Wisconsin Station. The gains from after-milking varied from 0.7 to 1.94 pounds of milk per head per day containing from 0.079 to 0.171 pound of butter fat. The results were slightly in favor of the Hegelund method as compared with stripping, "but the difference was so small that a definite statement in favor of either method can hardly be made." * * *

All the milk secreted by a cow should be drawn at each milking. If necessary, manipulation of the udder and stripping should be resorted to in order to accomplish this end. The after-milking should be done by the regular milker and need take but little extra time. It is probable that such clean milking is an incentive to secretion, and will increase the total yearly production of the animal.

It is the opinion of the writers that the stripping as well as the milking, except in unusual cases, should be done with the whole hand and not with the thumb and fore-finger alone. In milking, the thumb should be turned out and never inclosed within the palm, as is often done. The hand should be opened wide enough to allow the teat to fill to its full capacity, aided by a slight upward pressure upon the udder; the thumb and forefinger should then be closed, followed by the second, third, and fourth fingers in the order named.

COATING CHEESE WITH PARAFFIN.[a]

In an article on the curing of cheese in cold storage in a preceding number of this series,[b] the results of some experiments in coating cheese with paraffin were incidentally referred to. It was noted that at one experiment station (Wisconsin) paraffining cheese reduced the loss in weight during curing at 60° F. to the extent of about 50 per cent as compared with the loss in weight of unparaffined cheese. During curing at 40°, however, the loss in weight of the paraffined cheese was

[a] Compiled from Michigan Sta. Special Bul. 21; Ontario Agricultural College and Expt. Farms Rpt. 1902, p. 66, and Bul. 131; Wisconsin Station Rpt. 1899, p. 153; Dairymen's Assoc. Province of Ontario Rpt. 1902, p. 60.

[b] U. S. Dept. Agr., Farmers' Bul. 186, p. 30.

slightly greater than that of the unparaffined cheese. It is the intention of that station to test the accuracy of the latter observation by further experiments. While the experiments were considered too limited to draw general conclusions with safety, the results indicated that paraffining exerted no injurious influence on either the flavor or the texture of the cheese. It was stated that paraffining effectually prevented the development of mold. It was noted also in the article referred to that at another experiment station (New York State) the loss in weight during curing at temperatures of 40°, 50°, and 60° was greater in all cases in unparaffined than in paraffined cheese. At 60° the reduction in loss of moisture amounted to 5 or 6 pounds per 100 pounds of cheese. Paraffining in several cases improved the quality of the cheese. The growth of mold was entirely prevented, while unparaffined cheese was more or less heavily coated with mold.

In earlier work at the Wisconsin Station coating cheese with paraffin, when properly done, afforded complete protection against the growth of mold. The coating of new cheese was then thought to impair the flavor, while coating cheese three months old did not seem to have such an effect. A 10-pound cheese was coated at a cost of 0.7 of a cent.

In a recent bulletin of the Michigan Station, J. Michels reports that paraffined cheese stored for five or six months under commercial conditions had "a very fine flavor, good texture, scarcely any rind, and absolutely no mold." As regards the method of applying the paraffin, it was found at the Michigan Station that heating the paraffin to a temperature of 240° to 250° F. by means of a gasoline burner gave much better results than heating to 200° by the use of steam or hot water, as has been customary. The apparatus used for this purpose is shown in fig. 4.

The operation of this apparatus is thus described: "The cheese is supported on a wooden holder so constructed as to touch it at 4 points only, thus making no large breaks in the coat of paraffin. The small double pulley is quite essential so that the cheese may be lifted out of the hot liquid after a moment's immersion and may be held for a few seconds close to the surface that the surplus paraffin may drain off the sloping base of the cheese holder. The derrick permits the ready movement of the cheese from the table to the can and back. The whole apparatus should not cost over $10."

Dipping at the high temperature suggested required less paraffin and lessened the tendency of the coating of paraffin to crack. At 194° 0.256 pound of paraffin was required to coat a 44-pound cheese; while at 266° only 0.21 pound was required. The shrinkage of paraffined cheese when cured at both 65 and 38° was less than that of unpar-

affined cheese. "It was found that paraffin would stick rather better to the cheese itself than to the cloth circles, hence they were omitted, adding that small item to the saving in the matter of shrinkage. It is safe to estimate therefore the net economy on the side of the paraffined cheese as between 14 and 15 cents per 100 pounds of cheese, since it

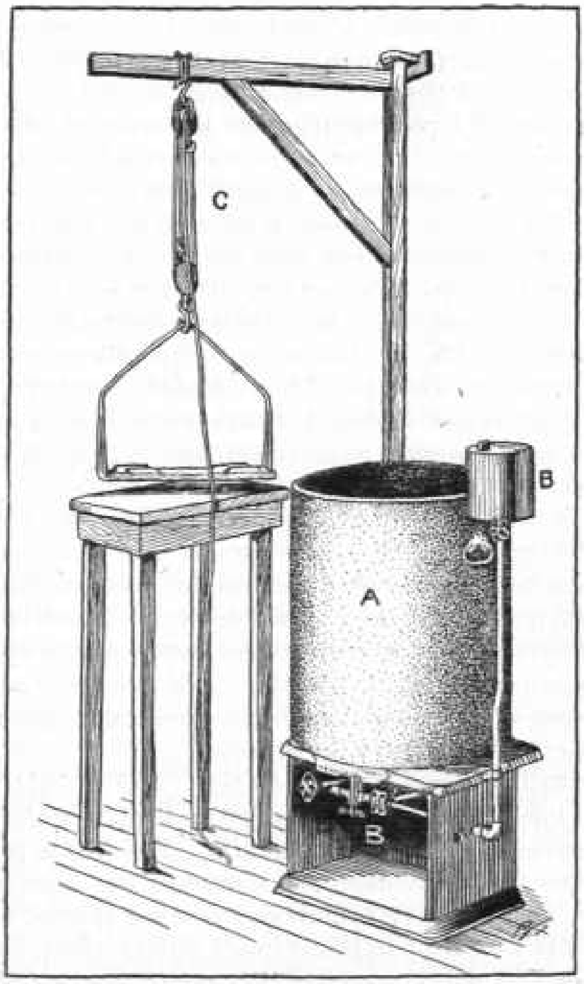

Fig. 4.—Apparatus for use in paraffining cheese. A—Metal tank containing the melted paraffin. B—Gasoline burner for heating the paraffin. C—Crane with pulleys and holder for lowering the cheese into the paraffin and withdrawing it.

cost less than 5 cents per 100 to paraffin." In addition it may be mentioned that the loss in rind in paraffined cheese was only 3.14 per cent, while in unparaffined cheese it amounted to 11.56 per cent, the comparison being made with cheese kept in cold storage for 38 days. The author states that cheese should be treated with paraffin within 2

to 12 hours after leaving the press, and that the best paraffin for this purpose has a melting point between 130° and 135°.

In experiments by H. H. Dean and R. Harcourt at the Ontario Agricultural College in 1902, cheeses were coated with paraffin at 180° when taken from the press and after intervals of 1, 2, and 3 weeks. As regards the appearance of the cheese, the best results were obtained by dipping in paraffin when about 1 week old and curing in cold storage. The scorings for appearance of 3 lots of paraffined cheese made in August and September and cured in cold storage averaged 6.33 points out of a possible 10, while the scorings of unparaffined cheese averaged 3.55. Unparaffined cheese made in October scored 6.5 for appearance, while cheese coated directly from the press scored 8.75; coated at the end of 1 week, 9.25; coated at the end of 2 weeks, 8; and coated at the end of 3 weeks, 7.5. As regards flavor, the average scorings of the different lots varied from 35.75 to 37.25, the highest possible score being 40. The average total scorings varied from 90 to 92.37. The chief advantage of paraffining was believed to be in the saving of shrinkage. Cheese coated directly from the press lost nothing in weight during 1 month, while cheeses coated at the end of 1, 2, and 3 weeks, respectively, lost 0.78, 1.57, and 2.36 per cent. Uncoated cheese lost 3.16 per cent.

From the work as a whole the authors draw the following conclusions: "Dipping the cheese in paraffin wax at a temperature of 180° makes a light coating over them, which prevents loss of weight while ripening or when held in cold storage. It also tends to prevent the growth of mold, and to some extent improves the appearance of the cheese, especially when placed in cold storage. So far as our work has gone we are not prepared to recommend the general paraffining of cheese to the ordinary factoryman."

It is admitted, however, that paraffining, if done promptly, in no way injured the quality of the cheese, whether kept in cold storage or in curing rooms at the ordinary temperature. It served to prevent a considerable loss from shrinkage and improved the appearance of the cheese. It is suggested that paraffining is better adapted to cold-cured cheese than to that kept in the ordinary curing room, and this view was expressed in the discussion at the annual meeting of the Dairymen's Association of Western Ontario in 1903.

The burden of testimony from experiments and practice would seem to be clearly in favor of paraffining, and, according to Maj. H. E. Alvord of this Department, some of the oldest and most intelligent and enterprising cheese merchants in this country are now coating cheese with paraffin upon a very large scale.

THE OCTAGONAL SILO.[a]

The construction and merits of the stave silo have been discussed in a previous bulletin of this series.[b] In a recent report of the Delaware Station, Dr. A. T. Neale cites the very favorable experience of farmers of that State with octagonal (eight-sided) silos built upon plans and specifications furnished by the station. "The octagonal silo may be regarded as a compromise between the old style square shaped, heavily framed or thick walled stone form and the modern lightly constructed stave silo, circular in shape and bound by iron hoops." The octagonal form of silo requires more material for the same cubic content than the round (stave) silo, but cheaper materials and those more readily available on the average farm may be used; the construction is somewhat simpler and is said to require less skill than in case of the stave silo; it is very substantial and durable, and probably requires less attention to keep in good condition than the stave silo, in which the damage due to alternate swelling and shrinking of the staves must be carefully guarded against. The octagonal silo has proved to be very efficient in the Delaware trials, excelling in this respect the square or rectangular silos and comparing very favorably with round silos. With the wide-angle corners of the octagonal form the loss from decay of silage is much less than in case of the square corners of the rectangular forms.

The construction of an octagonal silo 13 feet from face to face and 22 feet deep, having a capacity of 68 tons, when properly filled with well-settled corn and cowpea silage, is thus described by Doctor Neale:

> If eight pieces of seasoned white oak, each 3 inches thick, 6 inches wide, and 6 feet long, are so placed as to form a regular eight-sided figure with the corners bolted together, the sill of the silo will have been formed, and this drawn down into soft cement by the corner bolts, which extend into the masonry foundation 10 inches, will make an air-tight base. Posts of black or red oak, each 3 inches thick, 6 inches wide, and 18 inches tall, are set upright at each of the eight corners of this sill and firmly spiked to it; upon the top of said posts a second eight-cornered hoop of black or red oak, but in all other respects similar to the sill, is built. Seven similar hoops are in turn built one upon the other, upon posts which increase in length as the height of the structure increases, until the posts which bear the plate are reached, and these may safely measure 3 feet in length. These hoops may be compared with those which bind together the staves of a barrel. In the silo the staves are of inch boards, 1 foot wide, firmly nailed both to plate and sill, as well as to all of the intermediate hoops. These boards may be of hemlock or poplar, and of second or third rate quality, for their province is simply to hold plastering lath which, in turn, supports a coating of good cement. If after this cement has hardened and dried thoroughly it is treated to a coat of gas tar thickened with slate ground to flour, an enduring and perfectly impervious lining will result, examples of which after sixteen years in constant use may be cited in this State.

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[a] Compiled from Delaware Sta. Rpt. 1902, p. 30.

[b] U. S. Dept. Agr., Farmers' Bul. 103, p. 23.

Just as boards used as staves are nailed upon the inner surface of the hoops, so weatherboarding is nailed to their outer edges. When roofed to suit the owner's taste the silo is completed.

Cost of construction.

Cement, 7 barrels, at $2	$14.00
Lime used in masonry, 5 bushels, at 25 cents	1.25
Stone used in masonry, 4 perches, at 75 cents	3.00
Mason work on foundation	2.75
Sawmill work on 3 by 6, used in hoops, posts, etc	8.25
Bolts, nails, etc	9.73
Anchor bolts through sills	2.00
Roof rafters and window in dormer	5.00
Lathing and plastering	15.00
Lath, nails, and sundries	3.22
Lumber	57.40
Roofing paper	6.25
Carpenter's bill	22.25
Total	150.10

As already indicated, the nearer a silo approaches a cylinder in shape the greater will be its storage capacity for a given amount of material used in its construction. In this respect, therefore, the octagonal silo excels the rectangular form and the round silo is superior to the octagonal; but, as Doctor Neale points out—

When the practical work begins, when available material is examined, when permanence of structure and the amount and kind of labor involved in the work are considered, then the octagonal silo should be studied. For in very many sections of the State a farmer's own woodland will afford him the oak for frames and the poplar or pine for the sheathing and weatherboarding. His own men can make the logs and haul them to the sawmill, where, for a cash outlay ranging with localities between $4.50 and $5.50 per 1,000 board-feet, he can fill his lumber bill. In the expense account printed above the heaviest item is lumber, $57.40. The owner of that silo cut all of his framing timbers on his own land, and his bill at the sawmill was $8.25. He elected to purchase hemlock at $20 for sheathing, and white pine at $30 per 1,000 feet for weatherboarding; the result is an attractive appearing silo, but one on which the actual cash outlay could have been reduced by at least $30 had poplar, home grown, been available. On such silos high-priced labor is not absolutely necessary; the farmer and his boys, if handy with tools, can do nearly all of the work.

Octagonal silos without cemented linings are in use, and one in particular has been filled three times at least with satisfaction to its owner. This silo is 22 feet deep and a fraction more than 13 feet in diameter. Each of its hoops is made of eight pieces, in length approximately 6 feet. In size the silo is comparable with the one described [above] as costing $150 and holding 68 tons. [The owner of this silo] took all of his lumber from his own woods and paid $4.50 per 1,000 feet to the sawmill owner. As the only exception to this statement stands the weatherboarding, which he preferred to have of white pine and for which he paid the ordinary retail price. The lining is made of two thicknesses of chestnut boards with tarred paper between them. The actual cash outlay for the finished building was $60. This of course excluded all charges for carpenters and similar skilled labor, none of which was employed. By scale weight 60 tons of corn have been packed at one time into this silo. The wastes have been moderate and the lining shows few if any signs of

decay. The owner is, however, inclined to feel that losses of silage would have been smaller had he saved the money spent for paper and for the second lining of boards and in its stead used the lath and cement construction at possibly double his actual outlay.

The experience of another farmer which is cited bears out this conclusion.

VENTILATION OF STABLES.[a]

A sufficient supply of pure air is as indispensable to the well-being of the cow or horse as food and drink. Much of the disease which prevails among farm animals is undoubtedly due to close confinement in ill-ventilated, badly lighted stables. With the increased production of high-bred, high-priced stock it is becoming more and more apparent that it is not only humane but profitable to make adequate provision for the ventilation and sanitation of stables.

The need for ventilation arises from the fact that when the air of occupied stables is not changed the oxygen, which is the most important ingredient from the standpoint of animal life, is exhausted, and the air becomes contaminated with the exhalations from the lungs of the animals and from the manure, litter, etc. At the same time the conditions are rendered especially favorable for the growth and accumulation of disease germs. Poor ventilation, therefore, not only tends to weaken the animal system and to render it more susceptible to disease by furnishing an insufficient supply of the life-giving oxygen, but favors the growth of the germs which cause disease.

Professor King, formerly of the Wisconsin Station, gives the following table, adapted from one by Colin, showing the amount of pure air which must be breathed in order to secure the oxygen needed by different animals:

Air (and oxygen) required by different animals.

Animal.	Air breathed in 24 hours.		Oxygen consumed in 24 hours.	
	Per 1,000 pounds of weight.	Per head.	Per 1,000 pounds of weight.	Per head.
	Cubic feet.	*Cubic feet.*	*Pounds.*	*Pounds.*
Man	2,833	425.00	12.207	1.831
Horse	3,401	3,401.00	13.272	13.272
Cow	2,804	2,804.00	11.040	11.040
Swine	7,353	1,103.00	29.698	4.456
Sheep	7,259	726.00	29.314	2.931
Hen	8,278	24.84	24.840	.075

Since a cubic foot of air weighs about 0.08 pound, a cow requires 224.32 (2,804 by 0.08) pounds of air per day, or about twice the weight of solid and liquid food required. Assuming "that if the air is changed

[a] Compiled from Wisconsin Sta. Rpt. 1898, p. 281; Ontario Agr. Col. and Expt. Farms Rpt. 1901, p. 11, Bul. 119; Proc. Amer. Vet. Med. Assoc., 1901, p. 275; Physics of Agriculture, by F. H. King, p. 350.

in the stable at such a rate that it at all times contains no more than 3.3 per cent of air once breathed, fairly good ventilation would be provided," King calculates the number of cubic feet of air required per head hourly for different kinds of animals to be as follows:

Air required by different kinds of animals.

Kind and weight of animal:	Cubic feet per head hourly.
Horses (weighing 1,000 pounds)	4, 296. 0
Cows (weighing 1,000 pounds)	3, 542. 0
Swine (weighing 150 pounds)	1, 392. 0
Sheep (weighing 100 pounds)	917. 0
Hens (weighing 3 pounds)	31. 4

Theoretically perfect ventilation is not practically attainable, nor is it certain that it is necessary. A large amount of pure but cold air may be more objectionable than a smaller amount of less pure air of a higher temperature. In cold weather, when no artificial heat is used in the stable, free ventilation may result in a temperature too low for the health and comfort of the animals.

Professor Reynolds, of the Ontario Agricultural College, who has given much attention to the question of ventilation, says:

In warm seasons and in warm climates the problem of ventilation is a comparatively easy one. * * * But in the wintry season and in rigorous climates the question is one of considerable complexity, for along with the demand for fresh air comes another more immediately urgent—the demand for warmth. In cold weather these two requirements must necessarily conflict, and the one need is satisfied at the expense of the other. * * * In stables we have to guard against too great a reduction of temperature, and hence a system of ventilation in stables requires either careful watching or special appliances for warming the air. * * *

To introduce fresh cold air into a stable at any considerable rate and to draw off warmer air necessarily cools the stable, and may cool it below the point of comfort and safety. Without artificial heating the only safeguards against a temperature too low are: (1) A crowded stable, in which the animal heat given off is sufficient to warm large quantities of incoming air; hence the amount of ventilation may be, as it should be, in proportion to the number of animals in the stable. (2) A naturally warm, tight stable, which allows but little cold or drafts to enter the stable other than by ventilating arrangements. (3) Shut-offs in the inlet and outlet pipes, so that the amount of ventilation can be controlled according to the temperature of the incoming air, the principle being to get as much fresh air as is consistent with a proper stable temperature—between 35° and 45°. (4) A subearth duct, by means of which the fresh air, before being admitted to the stable, is carried for some distance through an underground pipe, 6 feet deep or more. The earth temperature at that depth being much higher than that of the outside air, the air is warmed in passing through the duct and enters the stable at a much higher temperature than it would if admitted directly. (5) Provision for drawing off the foul air at the floor, as an alternative to ceiling outlets. With floor outlets the air drawn off is colder than that drawn off at the ceiling, and hence the stable is not chilled so much. Ceiling outlets, however, encourage a more rapid ventilation, and it is therefore advisable to provide both—by extending the foul-air box to the floor, leaving the lower end open, and providing a flap in the box near the ceiling, to open or shut as is required.

In the great majority of farm stables the use of artificial heat and forced-draft devices to secure ventilation is impracticable. The heat of the animal body must be depended upon not only to maintain a suitable temperature in the stable, but to cause a movement of the air which may be utilized for the purpose of ventilation. To secure proper ventilation under such circumstances it is necessary to utilize all the natural forces that keep the air mixed and in motion, namely, unequal temperature, due to the heat given off by the animal body, the power of diffusion of gases, and the force of the wind.

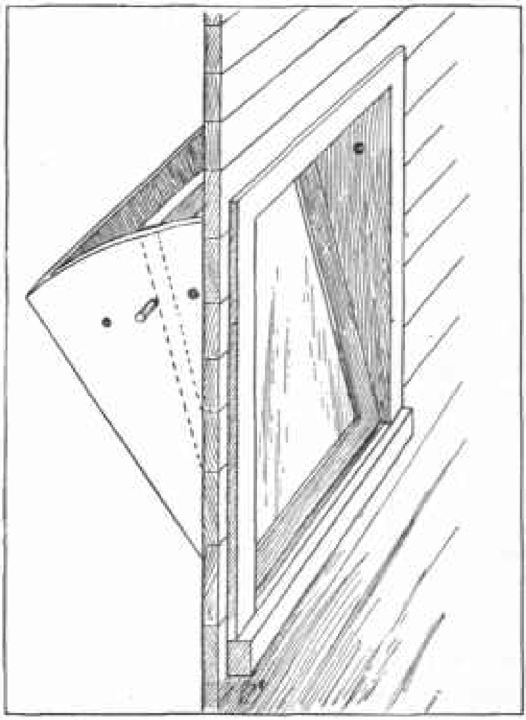


FIG. 5.—Hinged valve for ventilating stables.

The simplest means of providing ventilation is to admit air through windows at the sides and allow it to find its way out through the upper portion of the stable as best it may. This system is a makeshift and as ordinarily applied is very inefficient, although the use of windows (or valves), hinged at the bottom instead of at the top, the triangular space between the sash and the casing at the sides being closed (fig. 5), combined with ventilators in the roof of the stable, has given very satisfactory results.

According to Prof. J. B. Paige of the Massachusetts Agricultural College—

> The form of stable best adapted to [this system of] ventilation * * * is one not more than 40 or 45 feet in width, of any length desired. A monitor roof is desirable, but not essential. The animals should be arranged in rows on either side, facing a central passageway. (Fig. 6.) There should be 4 rows of valves, 2 below (one on either side in rear of the animals) situated 4 or 5 feet from the floor, and 2 above near the plates, or, better, in the sides of the monitor roof, provided the building is constructed on that plan. The lower row of valves, on the windward side of the building, should be open to admit fresh air; those above, on the opposite side, to allow for the escape of the foul air. By having numerous valves, each of which is opened but a little, the incoming current of air is evenly distributed throughout the building, and objectionable drafts prevented.

Another plan of construction, not requiring an extensive system of flues and recommended by Professor Paige as especially applicable to stables with straight walls and manure sheds on either side, provides

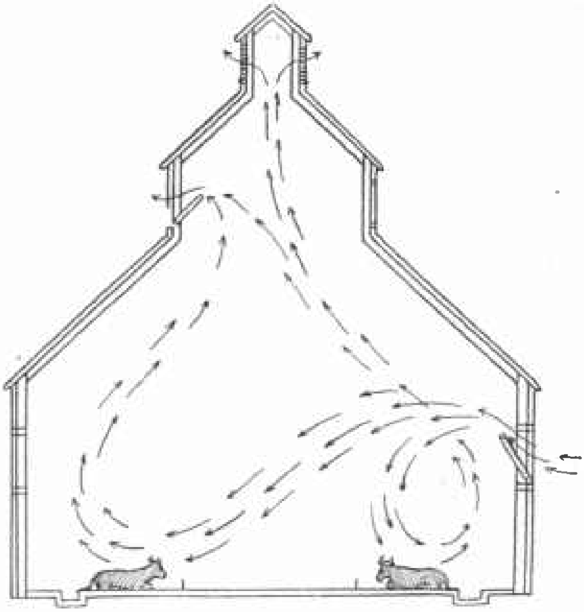


FIG. 6.—Cross section of monitor-roofed stable with hinged-valve system of inlets and outlets.

for the introduction of fresh air through openings in the manger fronts, and the escape of foul air through windows or cupola openings above. (Figs. 7, 8.) This system of inlets is used to good advantage only in those barns where the stable part is separate from the storage portion. There should not be a cellar under the stable. The arrangement of the animals should be the same as in [the system just described]. * * *

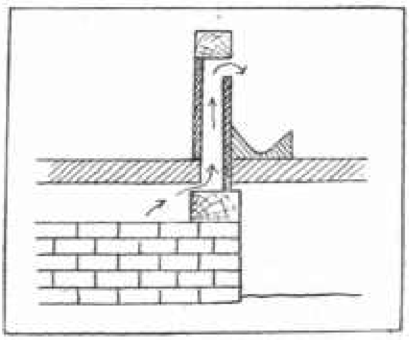


FIG. 7.—Device for ventilating through the manger front.

Under the floor of the central driveway, running lengthwise of the building, there should be a space or chamber having outside openings at the ends of the buildings. This space should be about 2 or 2½ feet in depth, of the same width as the driveway floor above. The openings at the end may be of any convenient size, preferably not smaller than 6 feet in length by 1 foot in width.

The opening space under the central section, which serves as a fresh-air chamber, must be completely separated from the two side spaces under the stall floors. Fresh air from the air chamber is taken into the stable through the manger fronts, which are built in the form of boxes, there being an opening at the bottom into the fresh-

air chamber, and another at the top into the stable. (Fig. 7.) With this arrangement, air is brought into the building and delivered directly in front of the occupants at the point where it is most needed. (Fig. 8.) From contact with the animals it becomes heated, rises, and, with the impurities that it has received from the animals, escapes through the outlets above.

This system possesses the advantage of being quite automatic. The air is brought in through numerous small openings, preventing uncomfortable drafts. It is introduced at just that point where it is most needed, and, again, each animal gets its supply of fresh air regardless of its position in the stable.

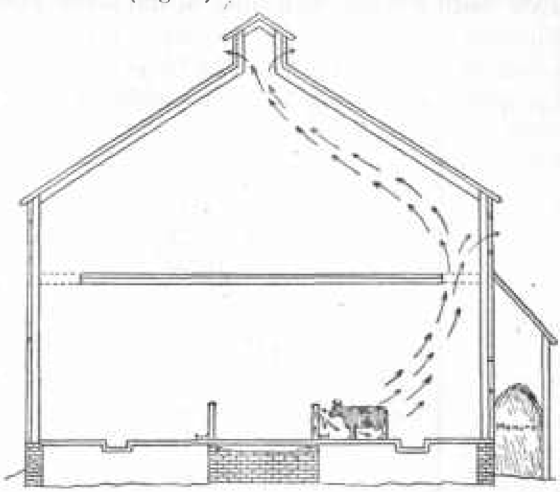
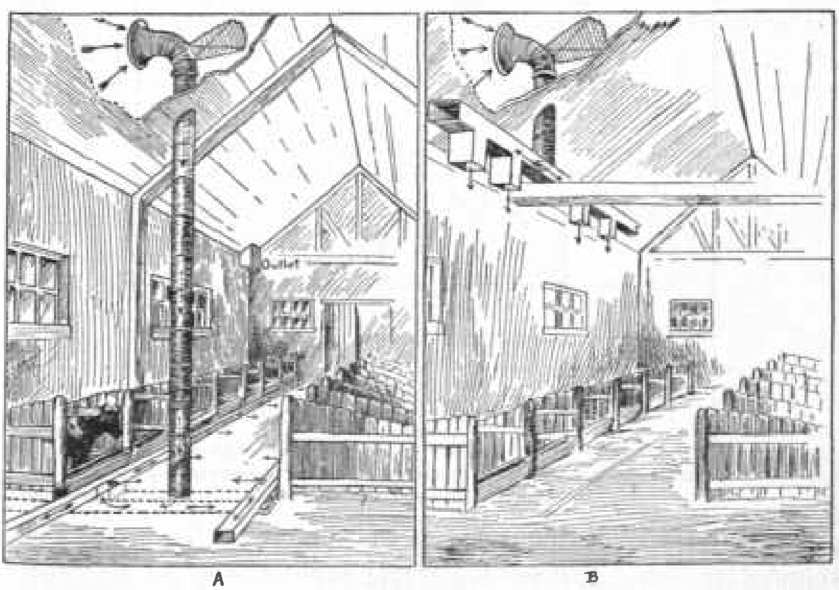


FIG. 8.—Cross section of a barn showing air chamber under driveway and ventilating device in the manger front.

In the system of stable ventilation employed by Professor Reynolds at the Ontario Agricultural College (fig. 9, A), fresh air is brought into the stables from the roof by means of pipes which terminate at the peak of the roof in revolving cowls 30 inches in diameter. The pipes con-



A B

FIG. 9.—A, The Massey system of ventilation used in part in the Ontario Agricultural College barn. B, Supplemental system of ventilation used in part in the Ontario Agricultural College barn.

nect below the roof with wooden boxes which carry the air through the ceiling of the stable to the floor and along the floor in front of the

mangers. In front of each stall there is a 4-inch opening in the box to let the fresh air into the passage. The foul air passes out through pipes leading from the ceiling of the stable through the roof and terminating in a roof-like top to protect them from wind and rain. This system is supplemented by one in which the air is admitted along the side walls near the top instead of at the floor. (Fig. 9, B.) The latter

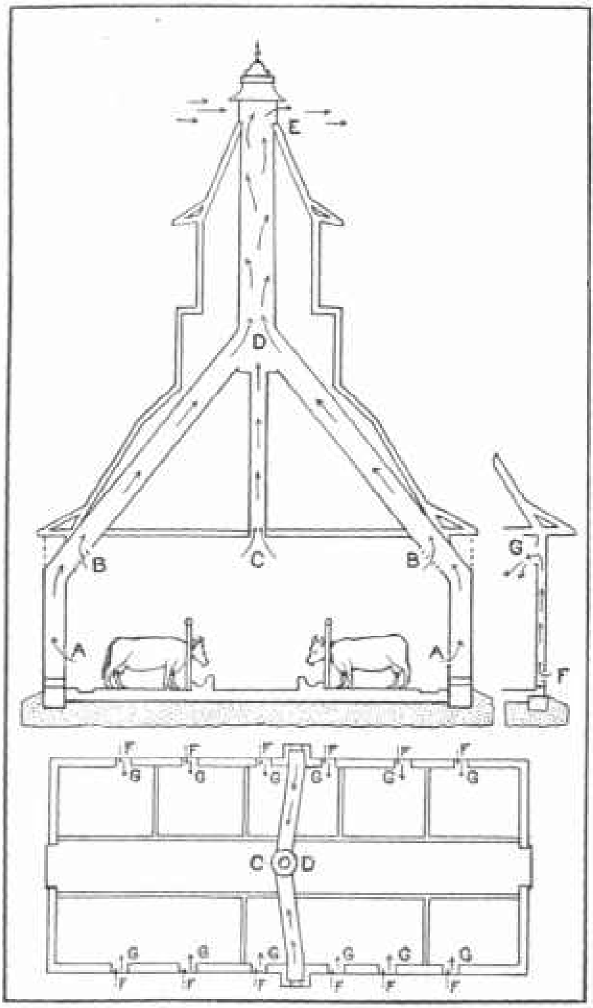


FIG. 10.—Cross section of the Wisconsin Station barn, showing system of ventilation devised by Professor King.

plan is better suited to old stables in which pipes can not be laid along or under the floor. A subearth duct may be substituted for the wooden pipe for distributing the air in the stable, but, according to Professor Reynolds, is better suited for use in winter than in summer, since "in summer the outside air, after passing through the underground duct, rises in relative humidity and becomes somewhat damp."

A system of stable ventilation devised by Professor King and suc cessfully employed in the Wisconsin Station barn is illustrated in fig. 10. As the figure shows "a single ventilating flue DE rises above the roof of the main barn, and is divided below the roof into two arms ABD, which terminate at or near the level of the stable floor at AA. These openings are provided with ordinary registers, with valves to be opened and closed when desired. Two other ventilators are placed at BB, to be used when the stable is too warm, but are provided with

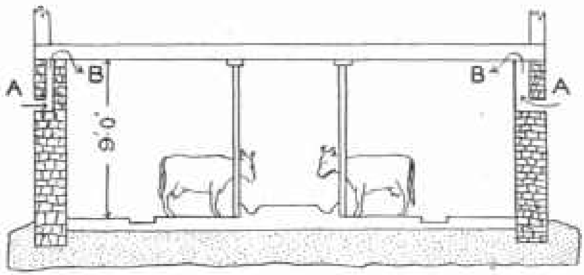


FIG. 11.—Simple methods of taking air into stone or basement stables.

valves to be closed at other times. C is a direct 12-inch ventilator leading into the main shaft, and opening from the ceiling, so as to admit a current of warm air at all times to the main shaft to help force the draft. This ventilating shaft is made of galvanized iron, the upper portion being 3 feet in diameter. The air enters the stable at various points, as shown in the plan at FG, and in the vertical section to the right by the arrows at FG."

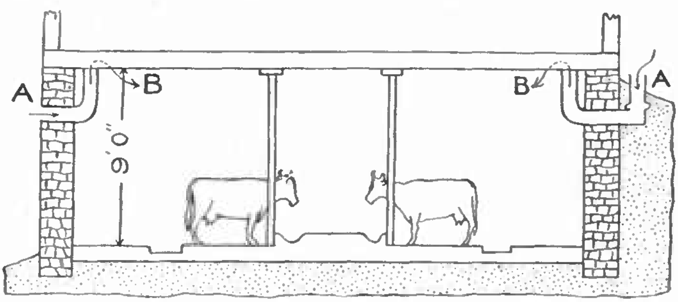


FIG. 12.—Method of taking air into a bank barn on the uphill or bank side.

Other plans described by Professor King for ventilating different kinds of stables are shown in figs. 11, 12, 13, and 14.

In fig. 11 "on the right a notch is left in the wall when building, so that the flue rises flush with the inside of the wall, while on the left side the flue is shown built in the wall. This may be done by building around 5-inch drain tile or around a box made of fencing."

Fig. 12 shows a "method of taking air into a bank barn on the uphill or bankside. The air flue is made in the same way as [that just]

described, but on the outside has its end covered as represented at A on the right with a length of 6 or 8 inch sewer tile with its top covered with a cap of coarse wire screen. Drain tile would not answer for the outside exposure at the surface of the ground as frost would cause it to crumble. Wood could be used and replaced after rotting has occurred."

Fig. 13 shows "two methods of ventilating a dairy barn. On the right the ventilating flue DF rises straight from the floor, passing out through the roof and rising above the ridge. One, two, or three of

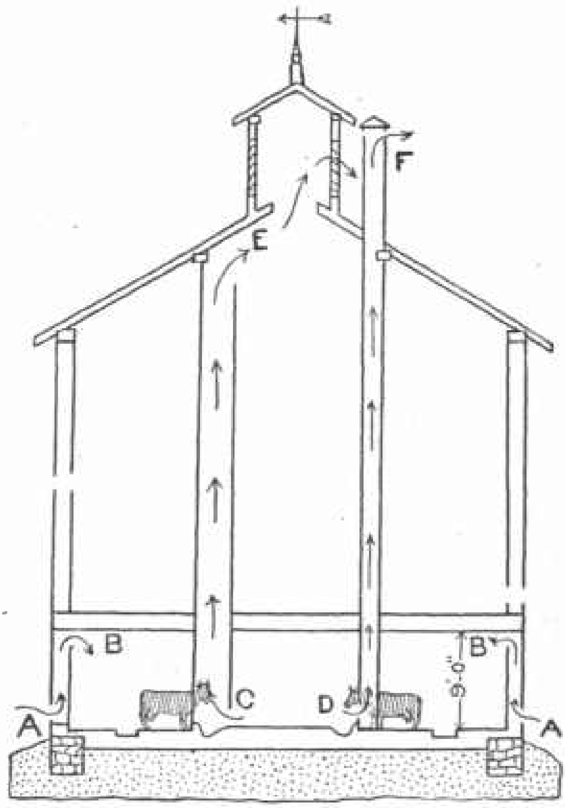


FIG. 13.—Section of a dairy barn showing two methods of ventilation.

these would be used according to number of cattle. The flues should be at one or the other side of the cupola rather than behind it. On the left CE represents how a hay shoot may be used also for ventilating flue. In each of these cases the ventilating flue would take the place of one cow. This method would give the best ventilation, but has the objection of occupying valuable space. C, in the feed shoot, is a door which swings out when hay is being thrown down, but is closed when used as a ventilator, the door not reaching quite to the floor. To take air into this stable, if it is built of wood with stud-

ding, openings would be left at A about 4 by 12 inches every 12 to 16 feet, and the air would enter and rise between the sheeting of the inside and the siding on the outside, entering at B as represented by the arrows."

Fig. 14 shows a "method of ventilating a lean-to stable. The air enters, as represented by the arrows at AB, and passes out through a flue built on the inside of the upright or main barn. This flue may rise directly through the roof, or it may end at E, as shown in the figure, the air passing through a cupola. If the upright barn has a balloon frame, then the space between the studding could be used as ventilating flues. * * * These flues could be made tighter by covering inside and out on the studding with the lightest galvanized iron."

It will be observed that in all cases the air is admitted to the stable at or near the ceiling, and may be allowed to enter the ventilating flue near the floor or ceiling or in the center of the ceiling, thus giving a variety of means of controlling the air current and securing more perfect circulation and mixing of the air.

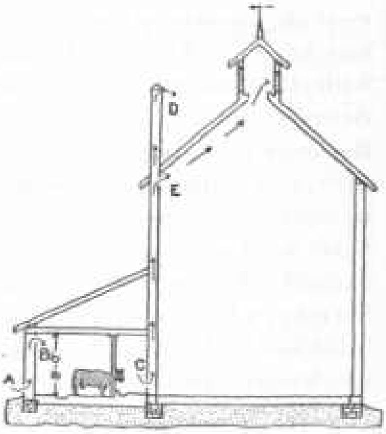


FIG. 14.—Method of ventilating a lean-to stable.

Professor King points out that a good ventilating flue must have all the characteristics of a good chimney. It should have as nearly airtight walls as possible; should rise above the highest part of the roof, so as to get the full force of the wind; should be as nearly straight as possible; should be located near the center of the stable, and should have an ample cross section. A few large flues are more satisfactory than a large number of small ones. It is estimated that when properly constructed one flue 2 by 2 feet, inside measure, will serve 20 cows, this number of animals being housed in a space not much less than 28 by 33 feet, with ceiling 8 feet in the clear.

According to Professor Paige, a round flue is preferable to a square one, because it has greater carrying capacity and no "dead" corners; smooth walls are better than rough, because they present less resistance to the current of air; flues on the south side of the building receive more heat from the sun and are more efficient than those on the north side; sharp angles should be avoided since each right angle reduces the velocity of the current one-half; flues should be so constructed that they can be kept clean in every part; very long flues are generally useless unless artificial heat is used to produce circulation of the air; drafts are best prevented and more perfect ventilation secured by having numerous small inlets rather than a few large ones.

DISPOSAL OF BODIES OF ANIMALS DYING OF CONTAGIOUS DISEASES.[a]

The bodies of animals dying of contagious diseases are a menace to the health of other animals, and even in some cases to that of man, if allowed to lie exposed above ground, and it has been found that in case of certain very virulent diseases, like anthrax,[b] ordinary burying is not an entirely effective safeguard. The germs of such diseases retain their virulence for many years, even in the soil, and are thus a constant source of danger. Of course if the diseased bodies are left above ground or thrown into a ditch or stream the danger of disseminating the disease is increased many fold. The most effective means that have been found for disposing of such diseased bodies are deep burying with free use of lime and burning.

As Professor McDowell, of the Nevada Station,[b] points out, the first method is probably best suited to small animals, like chickens, which may be quite effectively disposed of by burying at least a foot deep with about one-half pint of caustic (unslaked) lime. The second method (burning) Professor McDowell believes will in a series of years prove the most thorough and satisfactory. The owner may not always be sure of the cause of an animal's death, but if it is completely destroyed by burning, no matter whether the cause of death is disease or accident, no chances are taken of transmitting disease either to man or animals. In absence of a furnace, or specially prepared place for burning, a hole or trench 2 or 3 feet deep may be dug, a layer of brushwood placed on the bottom, and on this the body covered with brushwood sprinkled with kerosene. Open-air burning of course requires more time and fuel than would be necessary with a furnace. In a case cited by Professor McDowell the complete destruction of a 1,300-pound body required 5 gallons of kerosene oil, five-eighths of a cord of wood, and the time of two men, each for 2½ hours.

A neighborhood organization for burning animals, with special facilities, would, in all probability, decrease the cost of burning each animal. * * *

When it is necessary to move a dead animal, either for burning or burying, it is safer, provided the animal died of any contagious disease, not to draw it out on the ground with the chances in favor of scattering disease germs, but to draw the animal on a cheaply made sled, or "rock boat." If the animal is to be burned, the boat and all litter and bedding from the stall or yard where the animal has been kept should be burned also.

If the animals are burned in a specially made crematory, with one man doing the work by contract, then the sled or truck used in moving animals may be disinfected by the same method as that used for stock cars.

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[a] Compiled from Nevada Sta. Bul. 53.

[b] U. S. Dept. Agr., Farmers' Bul. 79, p. 23.

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